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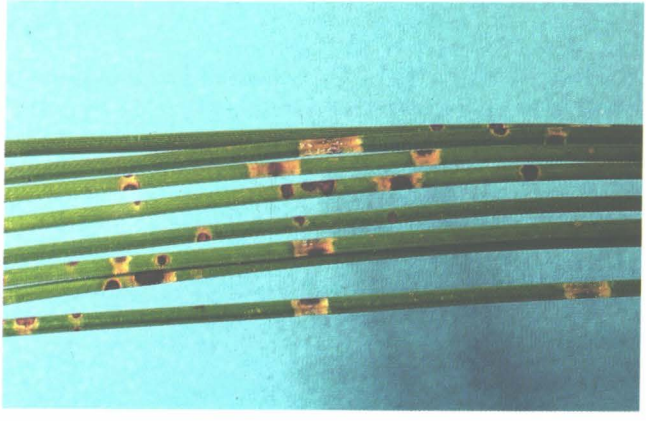
HOW TO

IDENTIFY AND CONTROL BROWN-SPOT DISEASE ON LONGLEAF PINE



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United States Department of Agriculture

Forest Service
Southern Region

Protection Report R8-PR 15

January, 1989

Cover pictures

Top left - Healthy longleaf seedling (no brown-spot symptoms).

Top right - Diseased longleaf seedling; 35 + percent of needles show brown-spot symptoms.

Bottom - Brown-spot symptoms (spots) on longleaf pine needles.

The Authors

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HOW TO IDENTIFY AND CONTROL BROWN-SPOT DISEASE ON LONGLEAF PINE

Longleaf pine (*Pinus palustris* Mill.) was once the dominant tree species on 60 million acres of virgin forests on the Sandhills and the Southern Coastal Plain. It was well adapted to these sites; was relatively resistant to fusiform rust caused by *Cronartium quercuum* f. sp. *fusiforme* (Berk.) Miy. ex Shirai; and was a valuable timber species. Currently, however, only about 5 million acres are forested in longleaf pine, and the species accounts for only about 2.5 percent of annual southern pine seedling production. Longleaf pine reforestation has declined due to the combined problems of inferior seedling quality, slow growth in the characteristic "grass" stage, and the extreme susceptibility of seedlings to brown-spot foliage blight, cause by *scirrhia acicola* (Dearn.) Sigg., during the grass stage. Heavily infected seedlings may remain in the grass stage for 10 or more years. Young trees are generally resistant to the disease after they grow out of the grass stage. Consequently, a major objective of longleaf pine regeneration techniques is to get the seedlings out of the grass stage as soon as possible. Recent research results have provided several promising techniques to achieve this objective.

Brown-spot can be controlled and longleaf pine can be brought out of the grass stage in 2 years with the use of the integrated pest management techniques recommended in this publication.

Distribution and Losses

Brown-spot needle blight is found from Virginia to Texas, primarily along the Gulf Coast and the Southeast Coastal Plain. The disease is more severe in certain geographic areas. The distribution of longleaf pine and disease hazard zones of brown-spot needle blight are shown in figure 1.

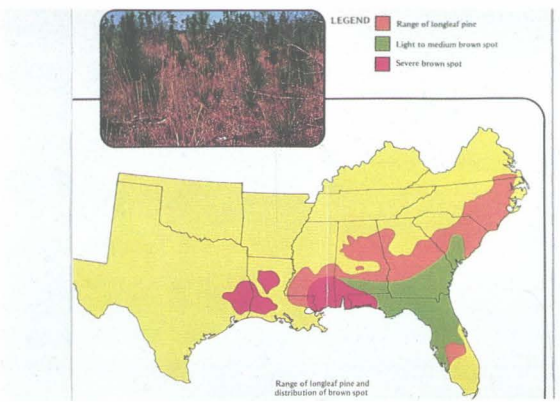
LEGEND
Range of longleaf pine
Light to medium brown spot
Severe brown spot
Range of longleaf pine and distribution of brown spot

Figure 1. — *Longleaf pine distribution and brown-spot disease hazard zones in the Southern U.S.*

Brown-spot needle blight is considered the most serious disease of longleaf pine in forest nurseries and young plantations. This disease causes significant growth losses and mortality (figure 2). Mortality of 50 percent or more has been observed in young longleaf pine stands thoughout the high-hazard disease range (figure 1). Annual losses to brown-spot needle blight in the South are estimated at 16 million cubic feet (453,000 cubic meters) of timber.

Figure 2. — *Severe brown-spot disease symptoms and damage on outplanted longleaf pine.*

Disease Identification

The disease occurs primarily during the grass stage before the tree starts height growth. Young needles are extremely susceptible to infection when first emerging from the needle sheath. Needle spots may appear at any time of the year, but they usually appear from May through October. The most common type of needle spot is straw yellow at first, changing to a light brown, often with chestnut-brown borders. The borders

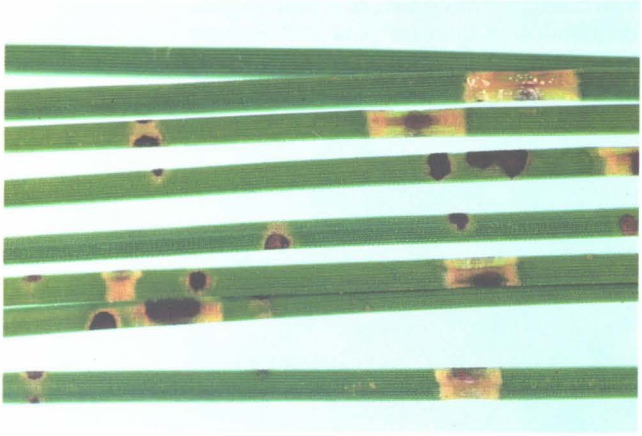

Figure 3. — *Brown-spot disease symptoms (spots) on longleaf pine needles.*

often turn to dark purple with the start of cool weather in autumn. Individual spots are usually about $^1/_8$ inch in diameter (figure 3). Needles with multiple infections take on a mottled appearance. Severely infected needles die.

The infected needle usually has three distinct zones: the green basal portion; the middle portion, which is mottled; and the tip consisting of dead tissue. With the gradual death of needles, the affected parts curve outward and down, finally assuming an orange-red color similar to needles killed by heat of a fire. After repeated infections, a seedling becomes a long needleless stem, with a tuft of severely infected needles growing at the base of the terminal bud. When active height growth is inhibited for many years, seedlings die.

Fungus Identification

The fungus causing brown spot on longleaf pine generally produces two types of spores, ascospores and conidiospores (conidia). See figure 4.

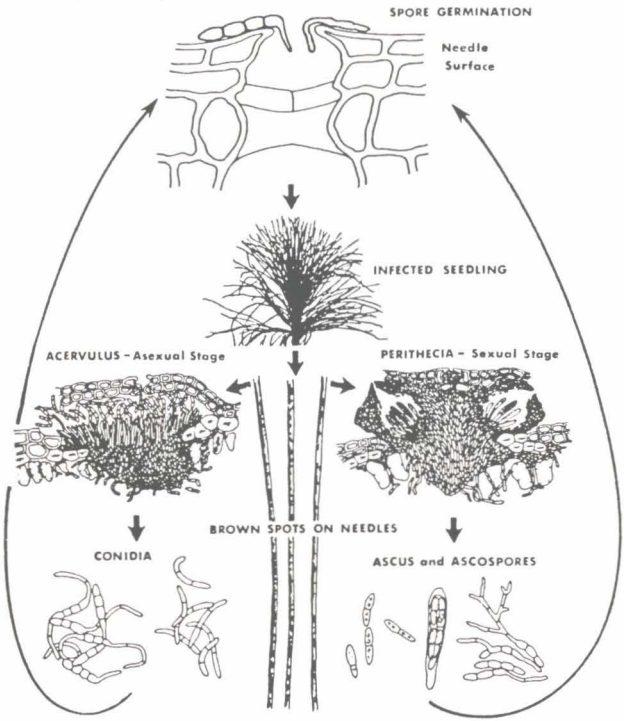

Figure 4 — *Life cycle of the brown-spot needle blight fungus on longleaf pine.*

Ascospores

These spores (figure 4) are windborne and cause scattered infections at great distances. They are probably the principal means by which brown spot starts in nursery beds and plantations established with disease-free seedlings. The spores also reinfect areas of planted or natural reproduction free of brown spot. They may even cause infections in the crowns of saplings and larger trees.

Conidiospores (conidia)

Once the fungus is established in an area, it intensifies and spreads each spring by conidiospores (figure 4). These are exuded in gelatinous masses that are washed and disseminated by rainsplash. Conidia cause primary infections near the tips of young elongating needles, usually in April. They also infect needle tips of subsequent needle flushes throughout the spring and summer. Conidia produced on the new needles cause secondary infections, and by June the needle tips begin to die back.

Significant differences in the virulence and pathogenicity of brown-spot fungus isolates have been reported.

CULTURING TECHNIQUES

A sure way to identify this disease is to culture the imperfect stage using the following sterile isolation techniques:

1. Soak 15 to 30 spotted needles in a 1:10 hypochlorite solution (household bleach and water) for about 1 minute to surface-sterilize them.

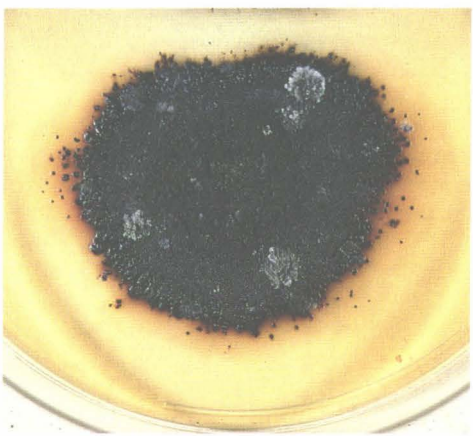

Figure 5. — *Brown-spot fungus morphological characteristics on artificial growth media.*

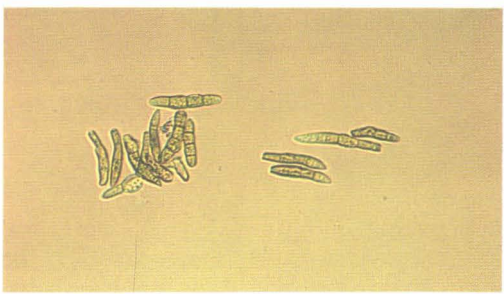

Figure 6.—*Brown-spot fungus spores (conidia) that are three- to to four-celled and rain splash disseminated.*

2. Remove needles from solution and cut a 3-mm section from each needle, being sure to include both healthy tissue and part of the needle spot.

3. Place needle sections on top of malt agar in a petri dish and incubate at about 25°C in the dark for 10 to 15 days. Examine the culture every 5 days.

The fungus grows slowly, producing masses of conidia in a dark, olive-green gelatinous matrix, mostly above the agar surface (figure 5). A white or grayish-white mycelium may grow around the margin of the culture or be scattered over the top. The spores are olive-green, crescent-shaped, and 3- to 4-celled (figure 6).

Another method for identifying the disease takes 2 to 3 days using needles that have acervuli (black specks). Wash infected needles having these specks with sterile, distilled water. Attach infected needles to the inside cover of a petri dish with waterproof adhesive tape. Place the petri dish cover on a dish containing moistened filter paper. Spray both top and bottom of the petri dish with sterile, distilled water. Cover and incubate at 25°C in the dark. Check after 24 hours and at 12-hour periods thereafter. When spore masses exude, remove from needles, place on cover slip, and verify the identity of the conidia of *S. acicola* as previously described.

INTEGRATED PEST MANAGEMENT

Nursery Seedling Quality

Superior-quality, disease-free, nursery-grown seedlings are mandatory for successful longleaf pine field plantings. Desirable characteristics of bare-root nursery longleaf pine seedlings are:

- Root collar diameter--0.4 inches (10 mm) or larger.
- Root length--6.0 + inches (15 + cm) and free of disease symptoms.
- Primary lateral roots--6.0 + first order laterals (2 + mm in diameter).
- Ectomycorrhizae--25 + percent of total feeder roots.
- Ectomycorrhizal fungus inoculations--inoculation of seedlings with the ectomycorrhizal fungus (*Pisolithus tinctorius* - Pt) has consistently improved nursery seedling quality along with field planting survival and growth.
- Winter buds--developed and functional.
- Needles--deep green color and dormant when lifted, with no evidence of brown-spot or other disease symptoms.
- Shoot:root ratio (weight/weight)--1:1 or better.

Controlled Burns

Timing of prescribed fires is very important. Burning for disease control is justified only when brown spot has developed to a damaging extent (when one-third of foliage is dead on most of the seedlings in late November or December). The prescribed burn should be performed the following January or February (figure 7). Burns should be made before a large percentage of the seedlings have started active height growth, because such seedlings are particularly vulnerable to fire.

Figure 7. — *Prescribed burn to control brown spot.*

Sites should be burned during the dormant season after the seedlings achieve a ground-line diameter of 0.3 inch (8 cm) and before they reach a diameter greater that 1 inch (2.5 cm). This practice reduces competition from grass and hardwoods, and destroys the fungal spores and diseased tissue that are present. Once seedlings are 3 feet (91 cm) or taller, they are seldom harmed by light fires at 3- or 4-year intervals, and these burns help to control competition and disease buildup. But remember that poor timing of fires can kill seedlings.

Shelterwood Regeneration

Another practical cultural method is shelterwood regeneration. This is the most promising approach to natural regeneration of longleaf pine in which seedlings are established as advanced reproduction under overstories of medium density. The pine overstory protects the regenerated seedling from serious brown-spot infection. Seed or shelterwood trees should be removed at seedling age 1 or 2 years.

Resistant Seedlings

One of the most important long-range controls for brown spot is the planting of resistant stock. Limited numbers of seeds from resistant parents are now available, and greater numbers will be available soon. One form of resistance to brown spot is the ability to grow quickly out of the grass stage. A family may be susceptible to the fungus but will be rated superior because it grows out of the grass stage before the fungus can suppress the seedlings.

Fungicidal Sprays

Brown spot is easily supressed by fungicidal sprays in nurseries. Seedlings may be sprayed with 4-4-50 Bordeaux mixture (4 lb [1.8 kg] copper sulfate, 4 lb [1.8 kg] hydrated lime, and 50 gal [189 liters] water) with hydraulic sprayers. Bordeaux mixture should be applied at the rate of 60 gal/acre (237 liters/acre). Chlorothalonil (Daconil or Bravo) has also proven to be effective. It should be applied at the rate of 2.5 lb/100 gal (1.1 kg/378 liters) of water with hydraulic sprayers.

Seedlings should be sprayed at 10- to 30-day intervals, depending on the amount of rainfall, from the beginning of April through October. It is important to initiate spraying in the spring when the newly emerging fascicled needles are 1 to 2 inches (2.5 to 5 cm) long. Usually four to six applications are sufficient.

Fungicide sprays are also a viable alternative for use on longleaf pines around the home, in landscape planting, and in other high-value plantings such as seed orchards. Three or four spray applications 8 to 10 weeks apart beginning in April and ending in October should be sufficient. The same rates as recommended for nursery control are adequate.

Benomyl Root Treatment

The systemic fungicide benomyl is recommended for use as a seedling root treatment prior to packing at the nursery or planting at the forestation sight for the control of brown-spot needle blight on longleaf pine. A single fungicide root treatment has provided effective brown-spot disease control in longleaf pine plantations for up to 3 years. Additional significant tree survival and growth benefits have been obtained on benomyl-treated seedlings in field plantings.

The longleaf pine seedling roots are treated in a slurry of benomyl, kaolinite clay, and water containing 1 pound benomyl (Benlate - 50 WP) and 9.5 pounds of dry kaolinite clay. Sufficient water should be added to form a semi-plastic clay slurry that will readily adhere to the moistened seedling roots. For consistent, effective results, the mixing tank should be continuously agitated, and the seedling roots should be sprayed with a relatively low pressure garden hose-type system rather than dipped in the mixture. This fungicide-clay mixture represents a dosage rate of 5 percent benomyl active ingredient (wt/wt). No surfactant or spreader-sticker is needed with this treatment. Do not apply the mixture to the seedling foliage. Avoid exposing the treated roots to abnormally high temperatures (i.e., above 90°F), freezing temperatures, or excessive drying conditions. Use special care to avoid loss of benomyl-kaolinite clay mixture from the treated roots during seedling packaging, storage, transport, and field planting. The seedling roots cannot be watered or treated with additional moist pesticides after slurry application. The kaolinite clay is the most effective carrier for the benomyl fungicide.

SUGGESTED READING

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PESTICIDE PRECAUTIONARY STATEMENT

Improper handling, application, or disposal of pesticides may be injurious to man, animals, and plants. Follow the directions and heed all precautions given by the manufacturer.

Store pesticides in original containers under lock and key -- out of the reach of children and animals -- and away from food and feed.

Apply pesticides so that they do not endanger humans, livestock, crops, beneficial insects, fish, and wildlife. Do not apply pesticides when there is danger of drift, when honey bees or other pollinating insects are visiting plants, or in ways that may contaminate water or leave illegal residues.

Avoid prolonged inhalation of pesticide sprays or dust; wear protective clothing and equipment if specified on the container.

If your hands become contaminated with a pesticide, do not eat or drink until you have washed. In case a pesticide is swallowed or gets in the eyes, follow the first-aid treatment given on the label, and get prompt medical attention. If a pesticide is spilled on your skin or clothing, remove clothing immediately and wash skin thoroughly.

NOTE: Some States have restrictions on the use of certain pesticides. Check your State and local regulations. Also, because registrations of pesticides are under constant review by the Environmental Protection Agency, consult your local forest pathologist, county agricultural extension agent, or State extension specialist to be sure the intended use is still registered.

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